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I, Robert Yampolsky, having knowledge of both the English and Japanese languages, hereby certify that I am responsible for the translation attached hereto, and that it is, to the best of my knowledge and belief, a true, accurate and complete translation into English of the Japanese patent application 2001-173408.

Robert Yampolsky

Robert Yampolsky

Sworn to before me this

1st day of April, 2004.

Signature, Notary Public

MIREILLE LAFONTANT
Notary Public, State of New York
No. 01LA6100385
Qualified in Kings County
Commission Expires October 20, 20 07

Stamp, Notary Public

# JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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|---|---|
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| Application Number: | Patent Application 2001-173408 |
| Applicant(s): | Hitachi, Ltd.<br>Hitachi Electronic Devices K.K. |

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Commissioner,
Japan Patent Office

Kouzou Oikawa

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Abstract: 1

Proof: Needed

[Document] Specification

[Title of the Invention] CRT

[Patent Claims]

[Claim 1]

A projection CRT comprising a panel having a luminescent screen formed on the inner surface thereof, a funnel, a neck portion, and a stem portion sealing the neck portion, wherein said neck portion has a first neck portion with a first neck outer diameter, which is the portion connected to the funnel, and a second neck portion with a second neck outer diameter which accommodates an electron gun emitting a single electron beam toward the luminescent screen; said first neck outer diameter is smaller than said second neck outer diameter; said electron gun comprises a main lens composed of a final electrode and a focusing electrode partially inserted into the final electrode; said final electrode has a large-diameter portion and a portion which gradually decreases in diameter toward the luminescent screen; and a high voltage applied to said final electrode is 25 kV or more.

[Claim 2]

The CRT according to claim 1, wherein said final electrode is formed from a second anode and a shielding cap.

[Claim 3]

The CRT according to claim 2, wherein said shielding cap has a portion with an inner diameter gradually decreasing toward the luminescent screen.

[Claim 4]

The CRT according to claim 2, wherein said shielding cap has a large-diameter portion and a small-diameter portion, and the main lens is formed from the large-diameter portion of said shielding cap and said focusing electrode.

[Claim 5]

The CRT according to claim 1, wherein neck graphite for supplying said high voltage is formed on the inner wall of said first neck portion and the inner wall of said second neck portion, and a valve spacer contact for electrically connecting said neck graphite and said final electrode is attached to said large-diameter portion of said final electrode.

[Claim 6]

The CRT according to claim 5, wherein said valve spacer contact is attached to said second anode.

[Claim 7]

The CRT according to claims 1 and 4, wherein the second neck shape is 36.5 mm or more.

[Claim 8]

The CRT according to claim 1, wherein the first neck diameter is 29.1 mm or less.

[Claim 9]

The CRT according to claim 1, wherein said first neck shape is 29.1 mm and said second neck outer diameter is 36.5 mm.

[Claim 10]

The CRT according to claim 1, wherein said high voltage is 30 Kv or more.

[Claim 11]

A projection CRT comprising a panel having a luminescent screen formed on the inner surface thereof, a funnel, a neck portion, and a stem portion sealing the neck portion, wherein said neck portion has a first neck portion with a first neck outer diameter in the portion which is connected to the funnel and a second neck portion with a second neck outer diameter; said first neck outer diameter is smaller than said second neck outer diameter; a main lens of an electron gun for emitting a single electron beam is located in said second neck portion: said main lens is formed from a final electrode and a focusing electrode partially inserted into the final electrode; said final electrode has a large-diameter cylindrical portion in the part where the focusing electrode is inserted, a small-diameter cylindrical portion on the luminescent screen side, and a portion which gradually decreases in diameter toward the luminescent screen; and a high voltage applied to said final electrode is 25 kV or more.

[Claim 12]

The CRT according to claim 11, wherein said small-diameter cylindrical portion of said final electrode is located inside said first neck portion.

[Claim 13]

The CRT according to claim 11, wherein the neck graphite for supplying said high voltage is formed on the inner wall of said first neck portion, and a valve spacer

contact for electrically connecting said neck graphite and said final electrode is attached to said small-diameter cylindrical portion of said final electrode.

[Claim 14]

The CRT according to claim 11, wherein said neck graphite is not located on the inner wall of said second neck portion.

[Claim 15]

The CRT according to claim 11, wherein a flange with a diameter smaller than the inner diameter of said small-diameter cylindrical portion is formed on the end of said small-diameter cylindrical portion of said final electrode on the luminescent screen side.

[Claim 16]

The CRT according to claim 1, wherein a cylindrical burring is formed on the inner side of said small-diameter cylindrical portion of said final electrode from the end portion on the luminescent screen side toward said focusing electrode.

[Detailed Description of the Invention]

[0001]

[Technological Field of the Invention]

The present invention relates to a CRT, more particularly to a CRT with improved focusing capability.

[0002]

[Prior Art Technology]

Image in a CRT is obtained by scanning an electron beam from an electron gun with a deflection yoke. The deflection yoke is disposed in the vicinity of the connection portion of a neck and a funnel. Deflection sensitivity increases with decrease in the neck outer diameter. If the neck outer diameter is decreased to increase the deflection sensitivity, the electron gun accommodated inside the neck also has to be made smaller. If the electron gun is made smaller, the electron lens diameter is reduced and focusing is degraded. Thus, deflection sensitivity and focusing capability are in a relation of conflict.

[0003]

A method for resolving this problem is suggested, for example, by USP 3,163,794, which states that deflection sensitivity can be improved by making the neck outer

diameter of a CRT smaller in the portion where the deflection yoke is mounted than in the portion where the electron gun is accommodated. The highest operation voltage of the CRT described in this patent is 16 KV. However, such a CRT has not yet found practical application. One of the reasons is that because the highest voltage is low, the merits of deflection power reduction are few. Furthermore, because the deflection yoke distance in the axial direction of the tube has to be constant, if the neck in an actual CRT has a two-step outer diameter configuration, the electron gun location is usually moved farther away from the luminescent screen due to mechanical restrictions. This results in side effects such as increase in CRT length and degradation of focusing capability.

[0004]

Japanese Patent Application Laid-open No. H11-185660 states that defection sensitivity is increased even in a color CRT by making the neck outer diameter in the portion where the deflection yoke is attached smaller than that in the portion accommodating the electron gun. However, such a CRT, too, has not yet found practical application. This can be attributed to the following reasons. A color CRT generates three electron beams arranged in line, but there is a risk of the two side electron beams coming near the inner wall of the neck tube in a contracted neck portion and of the electron beams striking the inner wall of the neck tube. For this reason, the neck diameter cannot be reduced to a large degree, and the effects are extremely small.

[0005]

[Problems Addressed by the Invention]

In a projection TV (PRT) operating at a high voltage of 25 kV or higher, with a single electron beam, and at a large electric current, if the neck outer diameter is decreased to improve deflection sensitivity, the electron gun accommodated in the neck portion also has to be decreased in size. If the electron gun is decreased in size, the electron lens diameter is decreased and focusing is degraded.

[0006]

[Means to Resolve the Problems]

The present invention relates to a CRT for a projection TV (PRT) operating at a high voltage of 25 kV or higher, with a single electron beam, and at a large electric current, wherein the neck outer diameter of the portion where a deflection yoke is disposed is made smaller than the neck outer diameter of the portion accommodating the electron beam. As a result, deflection power can be reduced and focusing capability improved. The consumption reduction effect of the deflection power in the PRT is much higher than in the usual CRT because: (1) the PRT operates at a high voltage, (2) scanning beams are usually used at two or three times the number in a usual TV, and (3) three PRTs are used in a projection TV. Furthermore, in the PRT the improvement of

spherical aberration caused by the increase in the aperture of electronic lenses is dominant over the degradation caused by electron beam spreading due to repulsion of electron beams. Thus, in the PRT, the effect produced by increasing the lens aperture of the electron gun is greater than the effect produced by withdrawing the electron gun from the luminescent screen because of the difference in neck diameter. Therefore, the effect of the present invention, for which the PRT configuration is a necessary condition, is very large.

[0007]

In the electron gun in accordance with the present invention, in order to avoid increasing the distance between the luminescent screen and the main lens of the electron gun, the final electrode of the electron gun is formed from a large-diameter cylindrical portion, a small-diameter cylindrical portion, and a portion with a gradually reducing diameter. The large-diameter cylindrical portion of the final electrode is disposed in the part of the neck with a large diameter, and the small-diameter cylindrical portion of the final electrode is located in the part of the neck with a small diameter.

[0008]

[Preferred Embodiments of the Invention]

FIG. 1 is a schematic cross-sectional view of the PRT in accordance with the present invention. A monochromatic image is formed in the PRT. There is only one electron beam. A luminescent screen is formed on the inner side of a panel 1. The panel 1 has a flat outer surface, and the inner surface thereof is convex on the electron gun side, thereby forming a convex lens. In the present embodiment, the panel has a spherical inner surface, and the curvature radius R is 350 mm. The inner surface can be also a non-spherical surface to reduce aberration. The thickness in the panel center is 14.1 mm. The diagonal exterior of the panel is 7 inches and the effective diameter between corners where the image is formed is 5.5 inches. The total length L1 of the PRT is 276 mm. A funnel 2 connects a neck portion 3 and the panel.

[0009]

The outer size of the neck portion 3 is 29.1 mm. A neck portion accommodating the electron gun has an outer diameter of 36.5 mm, which is larger than that of the neck portion 3. The neck outer diameter of 29.1 mm or 36.5 mm, as used herein, means an actual value that takes into account neck manufacturing error. A deflection yoke for deflecting an electron beam is disposed on the small-diameter neck portion 3. As a result, deflection power can be kept small. In this case, deflection power is reduced by about 25% compared to when the neck outer diameter is 36.5 mm. Because the electron gun is accommodated in the large-diameter neck portion 4, the diameter of the electron lens can be increased. A first grid 61 of the electron gas has a cap-like shape, and a cathode emitting an electron beam is accommodated inside the first grid 61. An accelerating

electrode 62 together with the first electrode 62 [sic] forms a prefocusing lens. An anode voltage of 30 kV, which is identical to the voltage applied to a second anode 65, which is a final electrode, is applied to a first anode 63. The anode voltage of the PRT is typically 25 kV or more.

[0010]

Due to mechanical restrictions caused by giving the outer diameter of the neck different diameters, the electron gun is moved farther from the luminescent screen. If the electron gun is moved farther from the luminescent screen, the focus is degraded. However, in the PRT, the problem of focusing degradation can be easily resolved by increasing the high voltage. The PRT can operate at a maximum voltage of 30 kV or higher.

[0011]

A focusing electrode 64 is split into a focusing electrode 641 and a focusing electrode 642. A focusing voltage of about 8 kV is applied to both electrodes.

[0012]

The distance L2 from the distal end of the focusing electrode 642 to the inner surface of the panel is 139.7 mm. The focusing electrode 642 has a large diameter on the luminescent screen side, and together with the second electrode 65 it forms a large-aperture main lens. The larger the neck outer diameter is, the larger the size of the main lens can be.

[0013]

Because the PRT requires a high brightness, the beam current (cathode current) is 4 mA or more. It is very important that the aperture of the main lens can be increased in order to maintain high focusing capability despite such a large electric current. In the PRT, because the voltage of the luminescent screen is high, a spread of the beam caused by repulsion of a spatial electric charge, especially in a large-current mode, is comparatively small, and the size of the electron beam spot on the luminescent screen in a large-current mode is essentially determined by the spread of the beam caused by spherical aberration of the electron gun.

[0014]

The shielding cap 66 is integrated with the second anode 65, forming the final electrode. The diameter of the shielding cap 66 on the side of the luminescent screen gradually decreases. It is reduced according to the decrease in the neck outer diameter in the vicinity of the distal end of the electron gun, and the electron gun is prevented from being separated by a large distance from the luminescent screen.

[0015]

The electrodes are fixed with a bead glass 67. The diameter of the shielding cap 66 on the luminescent screen side is substantially less than that of the second anode. A getter serving to increase the degree of vacuum inside the PRT is bonded to the electrode to prevent the degradation of voltage resistance. A ring-like getter 68 is connected to the shielding cap 66 with a getter support 681.

[0016]

FIG. 2 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the first embodiment. The second anode 65 and the shielding cap 66 overlap in the W portion and form a final electrode. The inner diameter DA of the second anode is 27.8 mm and is substantially identical to the inner diameter of the large-diameter portion 661 of the shielding cap. The focusing electrode 642 is introduced in the second anode and forms a large-aperture lens. The inner diameter DF of the distal end portion of the focusing electrode 642 is 20.5 mm.

[0017]

In the present embodiment, the main lens is formed substantially by a large-diameter portion 661 of the shielding cap 66 and the focusing electrode 642. The inner diameter DS of the small-diameter portion 663 of the shielding cap is 9 mm. This is done to prevent the adhesion of the getter to the focusing electrode 642 or the like and degradation of voltage resistance caused by a back flash when the getter 68 is scattered in order to increase the degree of vacuum. The inner diameter of the distal end of the shielding cap is 9 mm. The axial distance A from the distal end of the focusing electrode 642 to the rear end of the small-diameter portion 663 of the shielding cap is 10 mm, and the axial length B of the small-diameter portion 663 of the shielding cap is 10 mm.

[0018]

A valve spacer contact 69 serves to hold the inner wall of the neck portion and the electron gun at an adequate distance from each other and to supply a high voltage to the final electrode. In the present embodiment, the valve spacer contact 69 is mounted in a position corresponding to the neck outer diameter of 36.5 mm. In this case, a neck graphite 31 is formed in a location providing for sufficient electric contact with the valve spacer contact 69.

[0019]

FIG. 3 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the second embodiment. The difference between the embodiment shown in this figure and that shown in FIG. 2 is in that the connection

portion 662 from the large-diameter portion 661 to the small-diameter portion 663 of the shielding cap 66 is straight and has no steps. A specific feature of the present embodiment is that because the connection portion 662 is straight, the electron gun can be brought close to the luminescent screen side.

[0020]

FIG. 4 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the third embodiment. In the third embodiment, the valve spacer contact 69 is mounted on the small-diameter portion 663 of the shielding cap and is in contact with the inner wall of the small-diameter portion 3 of the neck. In this case, the neck graphite 31 may be coated only on the inner wall of the small-diameter portion of the neck. Since it is not necessary to extend the neck graphite zone to the large-diameter portion 4 of the neck, productivity and reliability are improved. The axial distance A from the distal end of the focusing electrode 642 to the rear end of the small-diameter portion 663 of the shielding cap in the present embodiment is 6 mm and the axial length of the small-diameter portion 663 of the shielding cap is 14 mm. The diameter DS of the distal end of the shielding cap is 21 mm.

[0021]

FIG. 5 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the fourth embodiment. The axial distance A from the distal end of the focusing electrode 642 to the rear end of the small-diameter portion 663 of the shielding cap in the present embodiment is 3 mm, and the axial length B of the small-diameter portion 663 of the shielding cap is 17 mm. In other aspects this embodiment is identical to the third embodiment. In the present embodiment, to the extent that the focusing electrode 641 is brought close to the small-diameter portion 663 of the shielding cap, the position of the main lens is brought close to the luminescent screen. Other dimensions are identical to those of the third embodiment. The axial distance from the distal end of the focusing electrode 642 to the distal end of the small-diameter portion 663 of the shielding cap is the same in the third embodiment and in the fourth embodiment. In the structures of the third and fourth embodiments, it is preferred that the distance from the distal end of the focusing electrode 641 to the distal end of the small-diameter portion 663 of the shielding cap is 20 mm or more, in order to prevent disturbance of the main lens electrical field.

[0022]

FIG. 6 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the fifth embodiment. This embodiment is identical to the third embodiment, except that a flange 664 is formed on the distal end of the shielding cap and the diameter of the distal end hole is 9 mm. In the present embodiment, the hole diameter in the distal end of the shielding cap is small. Therefore, the effect of the back flash of the getter can be decreased in comparison with that of the third embodiment.

[0023]

FIG. 7 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the sixth embodiment. This embodiment is identical to the fourth embodiment, except that a flange 664 is formed on the distal end of the shielding cap and the diameter DS of the distal end hole is 9 mm. In the present embodiment, the hole diameter in the distal end of the shielding cap is small. Therefore, the effect of the back flash of the getter can be decreased in comparison with that of the fourth embodiment.

[0024]

FIG. 8 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the seventh embodiment. In the present embodiment, a cylindrical burring 665 is formed from the distal end of the shielding cap in the direction of focusing electrode 632. The inner diameter DB of the burring is 9 mm, and the depth DD of the burring 665 is 10 mm. The burring 665 further decreases the effect of getter back flash. Other dimensions are the same as in the fifth embodiment.

[0025]

FIG. 9 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the eighth embodiment. In the present embodiment, a cylindrical burring 665 is formed from the distal end of the shielding cap in the direction of focusing electrode 632. The inner diameter DB of the burring is 9 mm, and the depth DD of the burring 665 is 10 mm. The burring 665 further decreases the effect of the back flash of the getter. Other dimensions are the same as in the sixth embodiment. A pin 5 [sic] for supplying a voltage to the electrode of the electron gun is sealed and secured in a stem 5. The base 52 protects the stem 5 and pin 51.

[0026]

FIG. 10 is a plan view of the stem portion of the present embodiment. The outer diameter SD of the stem is 28.3 mm and corresponds to an outer diameter of the neck of 36.5 mm. A specific feature of the present embodiment is that while the outer shape of the stem corresponds to the neck diameter of 36.5 mm, the pin circle PD1 is 15.12 mm which is equal to a neck diameter of 29.1 mm. Here, 15.12 mm is an actual value taking into account manufacturing error.

[0027]

For comparison, FIG. 11 shows a plan view of the usual stem portion when the outer diameter of the neck is 36.5 mm, the outer diameter of the stem SD is 28.3 mm and the pin circle PD2 is 20.32 mm. According to the usual design, if the neck diameter

increases, the pin circle increases accordingly. If the pin circle increases, the distance between the pins increases, which is advantageous in terms of voltage resistance. However, in the present embodiment, the outer size of the neck is 36.5 mm, but the pin circle is equal, for the reasons described below, to a pin circle in the case of a 29.1 mm neck.

[0028]

Part of the deflection circuit is connected to the pin 51, but because a deflection yoke corresponding to a neck shape of 29.1 mm is used, a circuit substrate identical to that in the case of a 29.1 mm neck can be used if a pin circle is equal to a 29.1 mm neck. Further, a connector for a 29.1 mm neck which has a higher utility can be also used.

[0029]

FIG. 12 shows the PRT in accordance with the present invention having a deflection yoke 7, a convergence yoke 8, and a speed modulation coil 9 installed therein. The deflection yoke 7 is mounted on a small-diameter neck portion 3. The convergence yoke 8 is mounted on the large-diameter neck portion 4. Mounting the convergence yoke 8 on the large-diameter neck portion 4 prevents the length of the PRT from increasing excessively. If the length of the PRT is allowed to increase and the convergence yoke 8 is mounted on a neck portion with a small diameter, the sensitivity of the convergence yoke can be increased. Furthermore, the deflection yoke 7 and the convergence yoke 8 can be easily integrated.

[0030]

In a projection TV, as shown in FIG. 13, images from three PRTs—a red PRT 10, a green PRT 11, and a blue PRT 12—pass through the lens 13 and are converged on a screen 4 to form an image. This convergence is conducted by inclining the PRT with respect to each other, and fine tuning is carried out with the convergence yoke 8 mounted on each PRT.

[0031]

A speed modulation coil is used for improving the image contrast. Because the speed modulation coil is disposed in a portion with a neck outer diameter of 36.5 mm, sensitivity becomes a problem. In order to increase sensitivity of the speed modulation coil, the focusing electrode 64 is divided into an electrode 641 and an electrode 642 and a gap is formed between the electrode 641 and the electrode 642, thereby facilitating the effect of magnetic field of the speed modulation coil on the electron beam.

[0032]

FIG. 14 is a schematic cross-sectional view of a projection TV. An image from the PRT 11 passes through the lens 13 and is reflected by a mirror 15 and projected on the screen 14. As shown in FIG. 6, the total length of the PRT does not directly affect the depth of the projection TV. Furthermore, because a projection TV uses three PRTs, the economy of deflection power consumption is threefold that of the usual TV. Furthermore, a projection TV is usually a large-screen TV with a screen diagonal of 40 inches or more. In such a large screen, with the usual NTSC signal, the scanning lines stand out, degrading the image quality. In order to avoid this effect, an advanced TV system with a large number of scanning lines is most often used in the projection TV. In this case, the number of scanning lines is 2-3 times that of the usual NTSC system and the deflection power increases. Therefore, if a PRT based on the present invention is used, the reduction of deflection power consumption in the projection TV will produce a very large effect. The present invention can be applied not only to a projection TV, but also to a usual projector using three PRT.

[0033]

[Effect of the Invention]

In accordance with the present invention, the deflection power can be suppressed and the diameter of electron lens can be increased.

[Brief Description of the Invention]

FIG. 1 is a cross-sectional view of the PRT in accordance with the present invention.

FIG. 2 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the first embodiment.

FIG. 3 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the second embodiment.

FIG. 4 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the third embodiment.

FIG. 5 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the fourth embodiment.

FIG. 6 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the fifth embodiment.

FIG. 7 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the sixth embodiment.

FIG. 8 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the seventh embodiment.

FIG. 9 is a partial enlarged view of the electron gun in the vicinity of the main lens, this view illustrating the eighth embodiment.

FIG. 10 is a plan view of a stem portion of the PRT in accordance with the present invention.

FIG. 11 is a plan view of a stem portion relating to a configuration with a usual 36.5 mm neck.

FIG. 12 is a cross-sectional view of the PRT in accordance with the present invention, which has a deflection yoke, a convergence yoke, and a speed modulation coil installed therein.

FIG. 13 is a general view illustrating a plan configuration of a projection TV.

FIG. 14 is a schematic longitudinal sectional view of a projection TV.

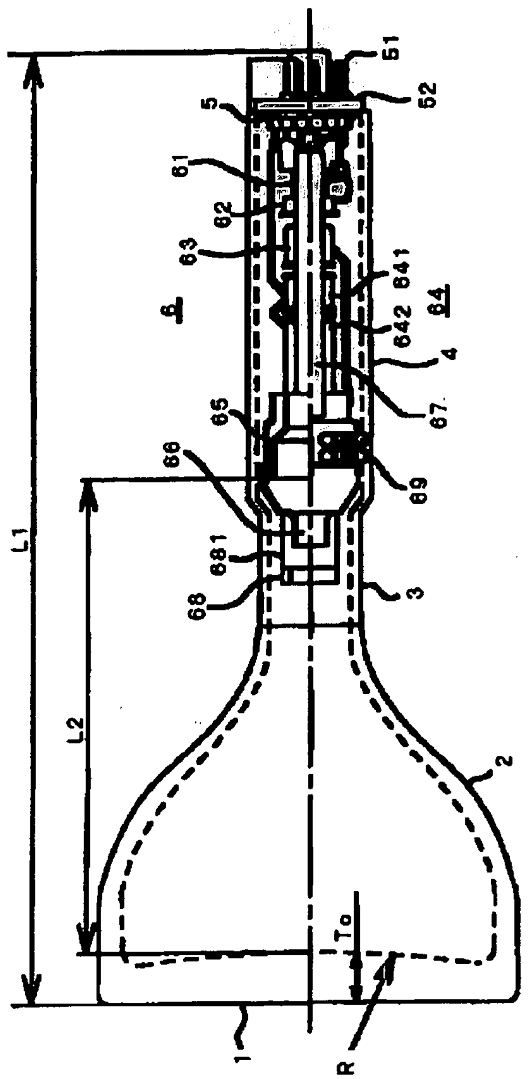
[Keys]

| | |
|---|---|
| 1 | PANEL PORTION |
| 2 | FUNNEL PORTION |
| 3 | NECK PORTION |
| 4 | NECK PORTION ACCOMMODATING AN ELECTRON GUN |
| 5 | PIN |
| 6 | ELECTRON GUN |
| 61 | FIRST GRID |
| 62 | ACCELERATING ELECTRODE |
| 63 | FIRST ANODE |
| 64 | FOCUSING ELECTRODE |
| 65 | SECOND ANODE |
| 66 | SHIELDING CAP |
| 7 | DEFLECTION YOKE |
| 8 | CONVERGENCE YOKE |
| 9 | SPEED MODULATION COIL |

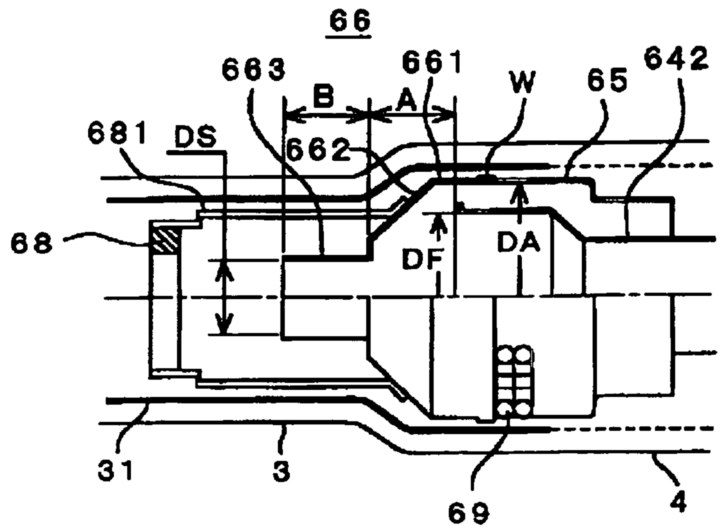
Filed on June 8, 2001

Control Number: 330100279 Patent Application 2001-173408

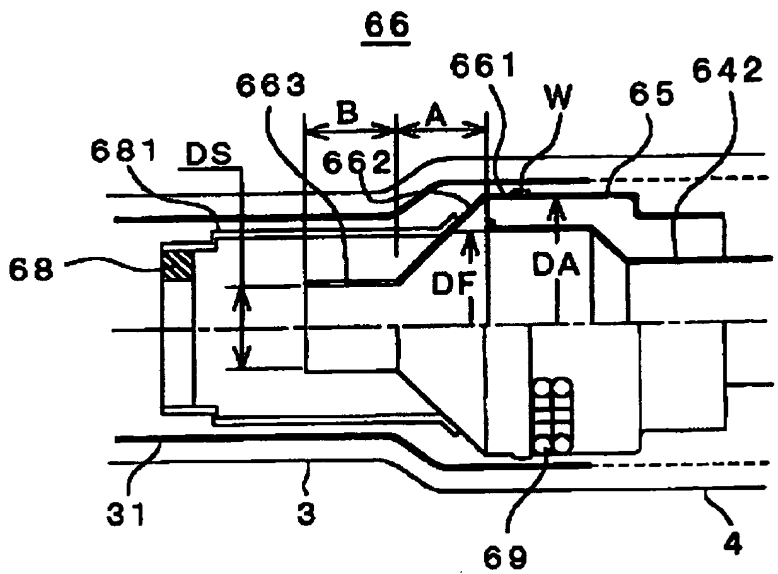
[FIG. 1]



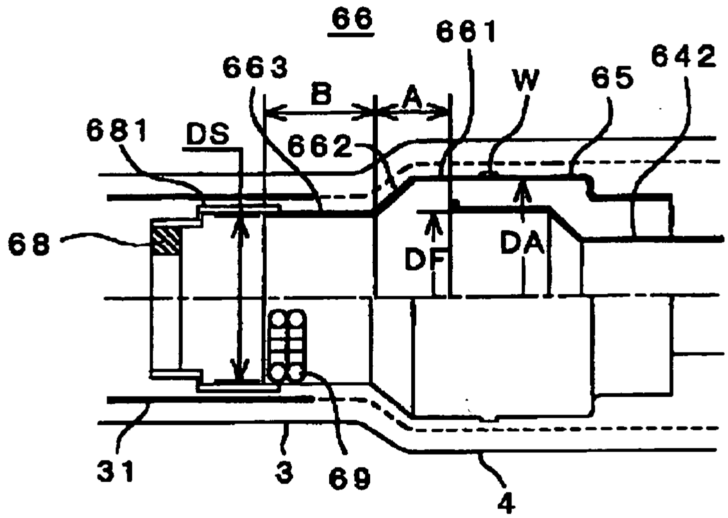
[FIG. 2]



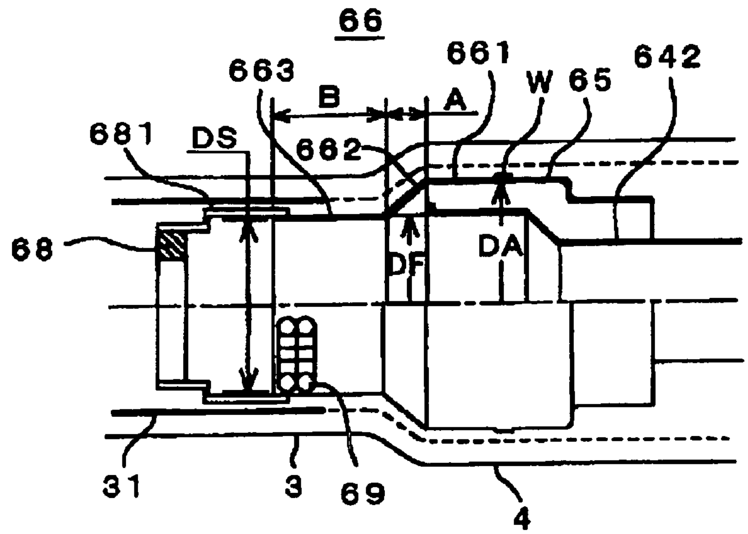
[FIG. 3]



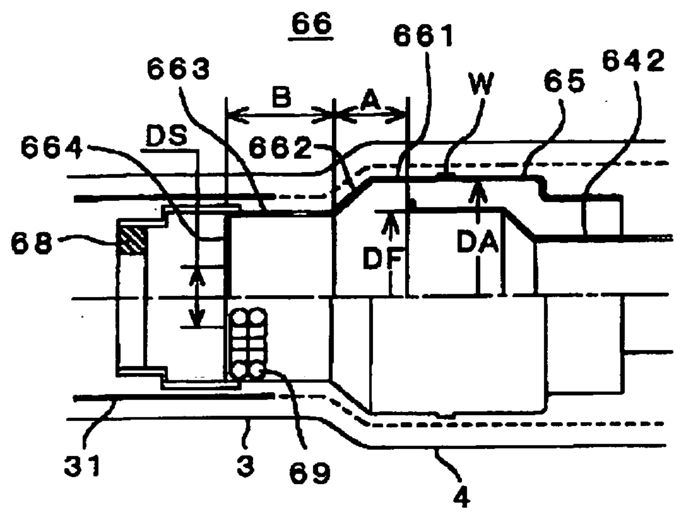
[FIG. 4]



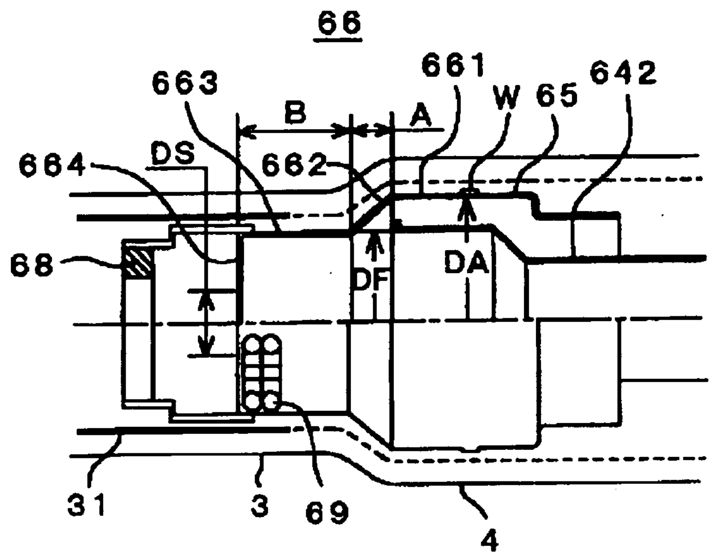
[FIG. 5]



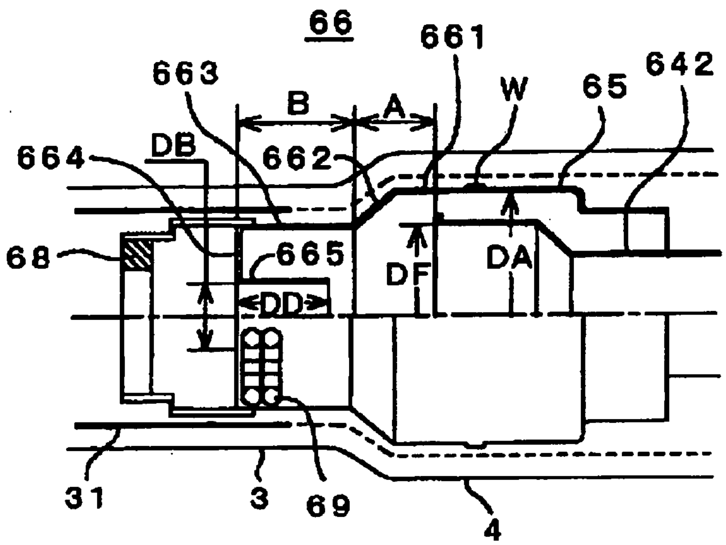
[FIG. 6]



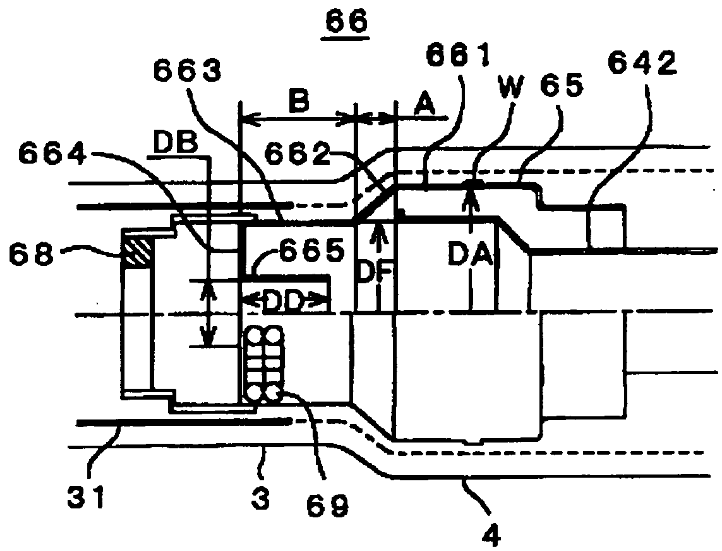
[FIG. 7]



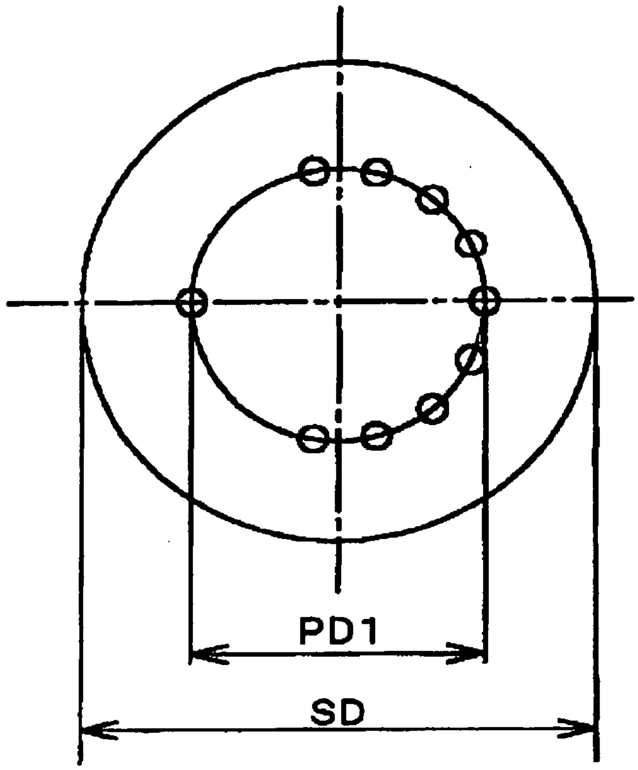
[FIG. 8]



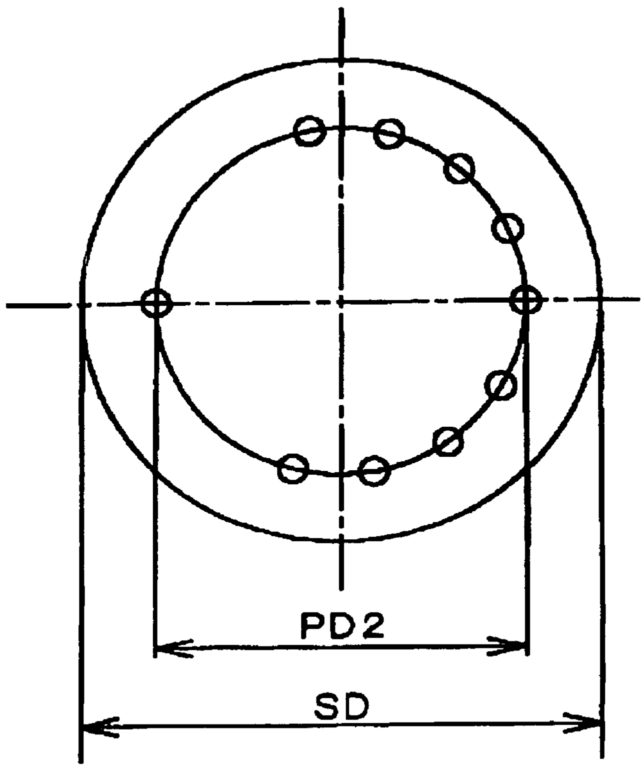
[FIG. 9]



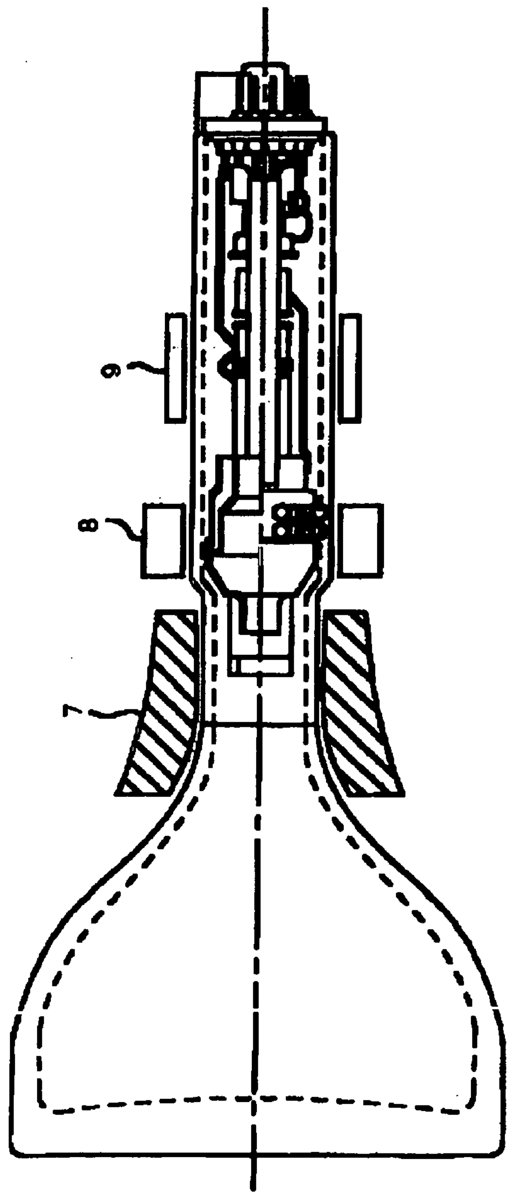
[FIG. 10]



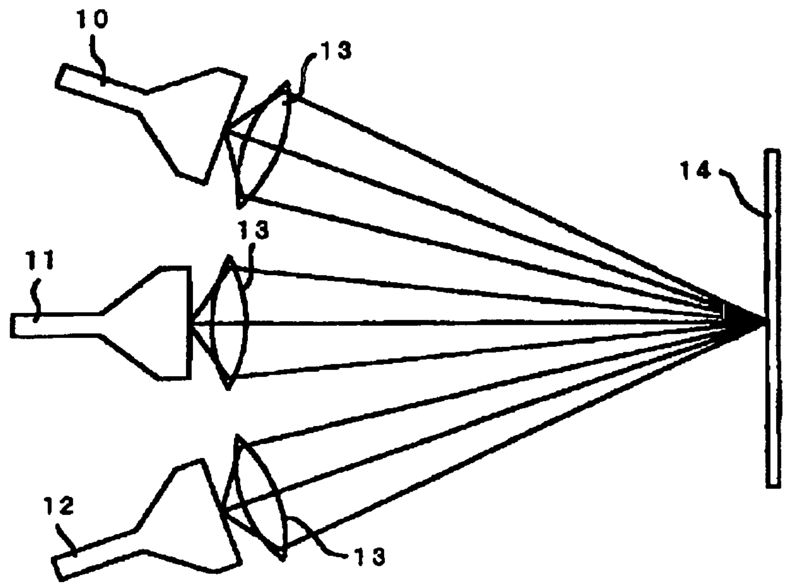
[FIG. 11]



[FIG. 12]



[FIG. 13]



[FIG. 14]